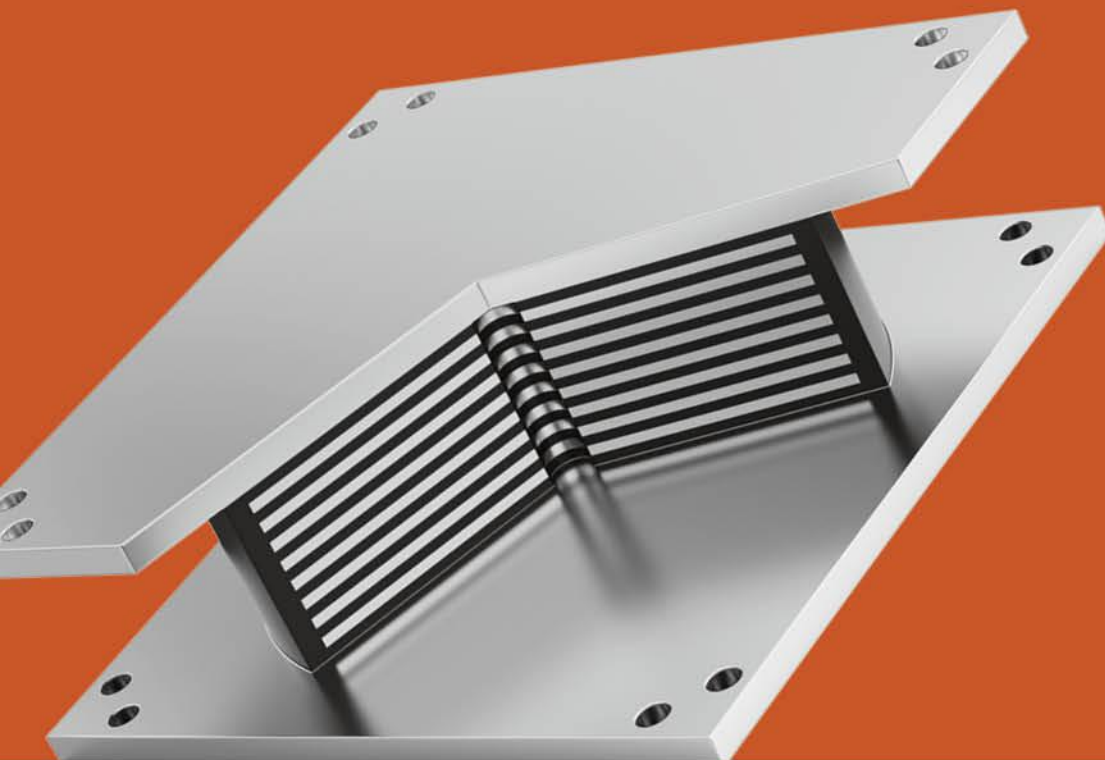


Seismic Isolation

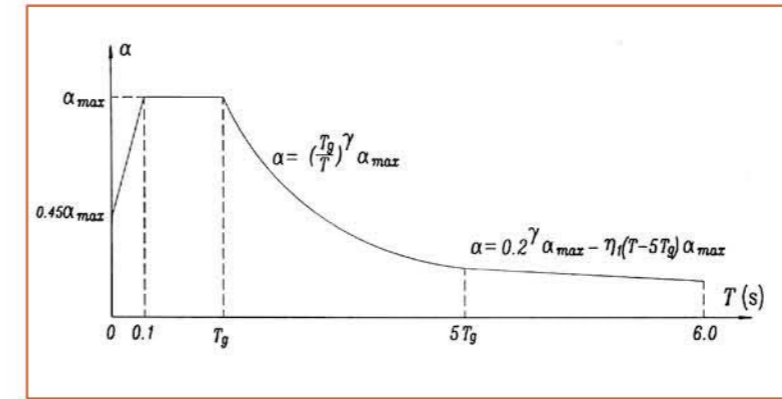


**Damping and
Isolation Device
For Buildings**

Introduction

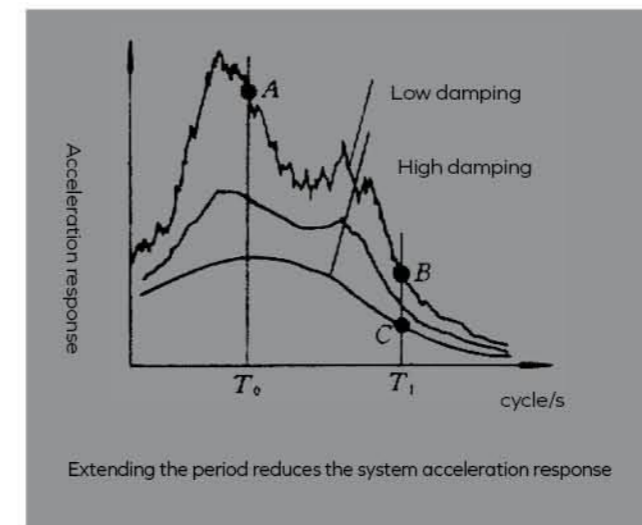
Earthquakes are sudden release of energy in the form of seismic waves generated by rapid rupture of the Earth's interior layers, causing ground movements/ vibrations within a certain range. Throughout the history, destructive earthquake has always been the leading cause of disasters in structures. For this reason, isolation technologies including seismic bearings have been widely used over the past few decades and showed a significant effectiveness during numerous earthquakes.

Seismic isolations are crucial components of structure. They have now become an established and accepted technology all over the world especially for sensitive buildings including hospitals or emergency facilities which need to give a full service after an earthquake.

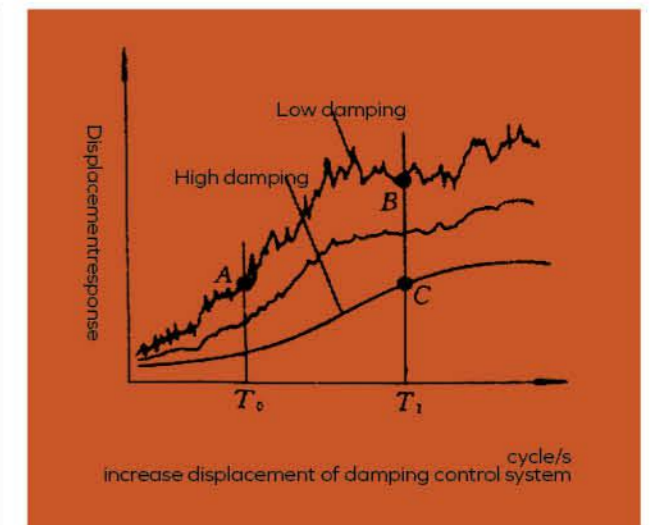


Prolong the natural vibration period of the structure

"Isolation" can extend the structural period by more than 2 times. According to the response spectrum, the seismic impact coefficient decreases with the extension of the period.

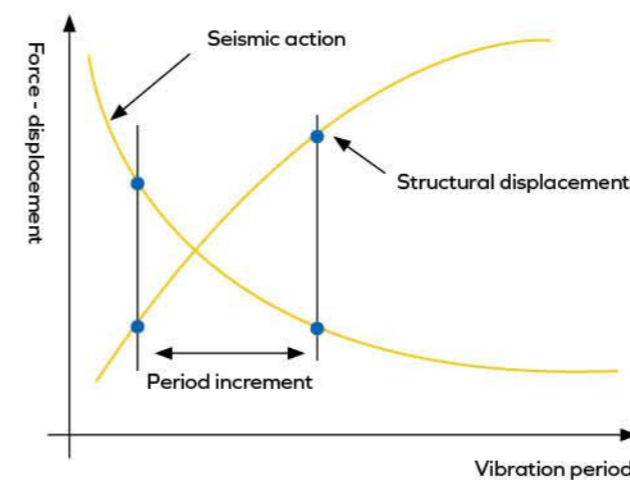


Extending the period reduces the system acceleration response



Increase displacement of damping control system

Increase structural damping



The change rule of force and displacement with the period of natural vibration

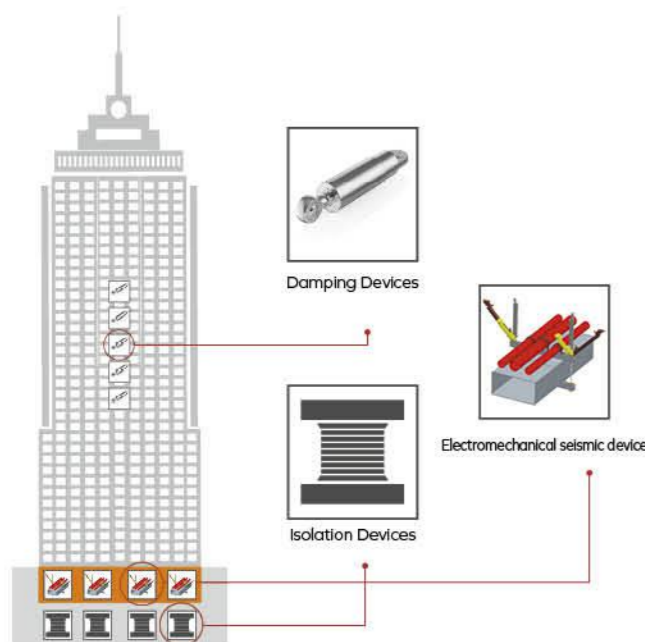
Seismic isolation products have been part of Tiantie's product offering since 2019. The company is a recognized industry leader and has received numerous patent awards for product innovation. Tiantie seismic bearings are well-suited for all common buildings and are proven to perform reliably over a very long service life.

Tiantie recommends the most suitable products according to the specific needs of customers. The products can be tailor-made and formulated with a specific design plan and supporting technical service plan according to the specific requirements of the project.

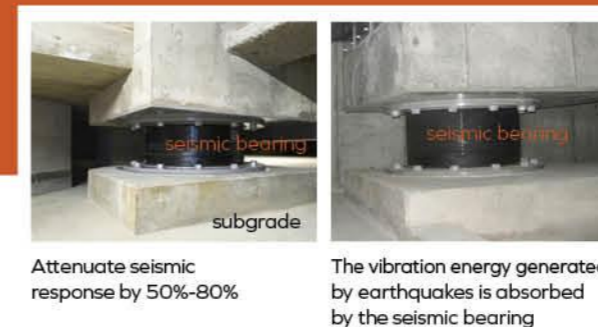
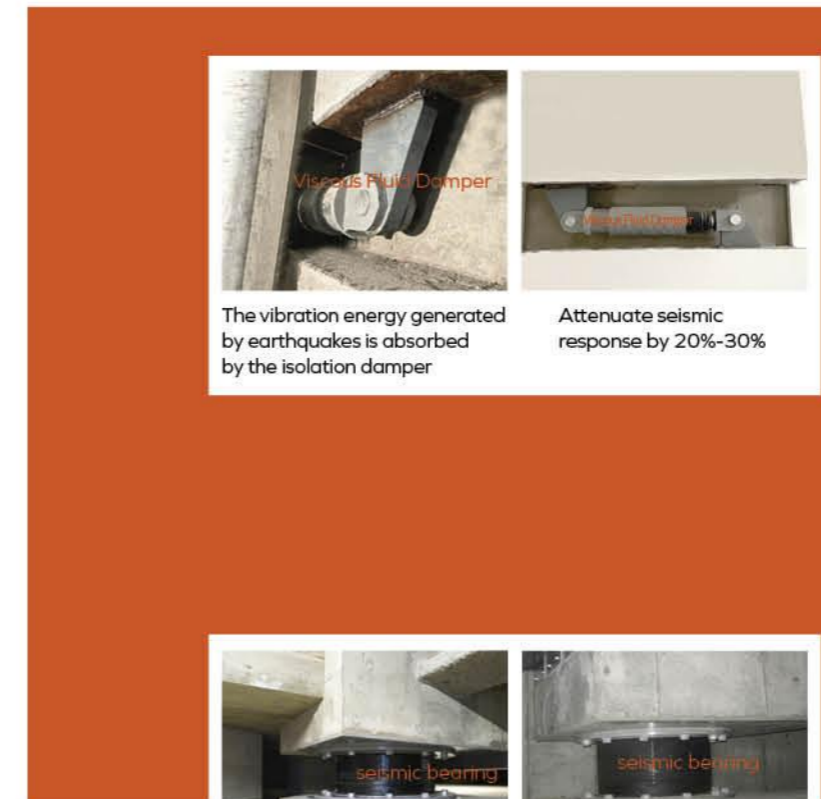
Tiantie's seismic isolation products meet the highest requirements of national, industry and local standards, and reach the international advanced level and have a high production efficiency and short lead time.

Building bearings

Principles



Seismic bearings limit the horizontal displacement and decrease the transferring seismic energy from the ground to the structure to a minimum amount at the time of high intensity earthquake occurrence by causing the structure to move virtually as a rigid body on the isolators and the bearing accommodate large deformations at the interface by decoupling the structure from its foundation to reduce the seismic impact.

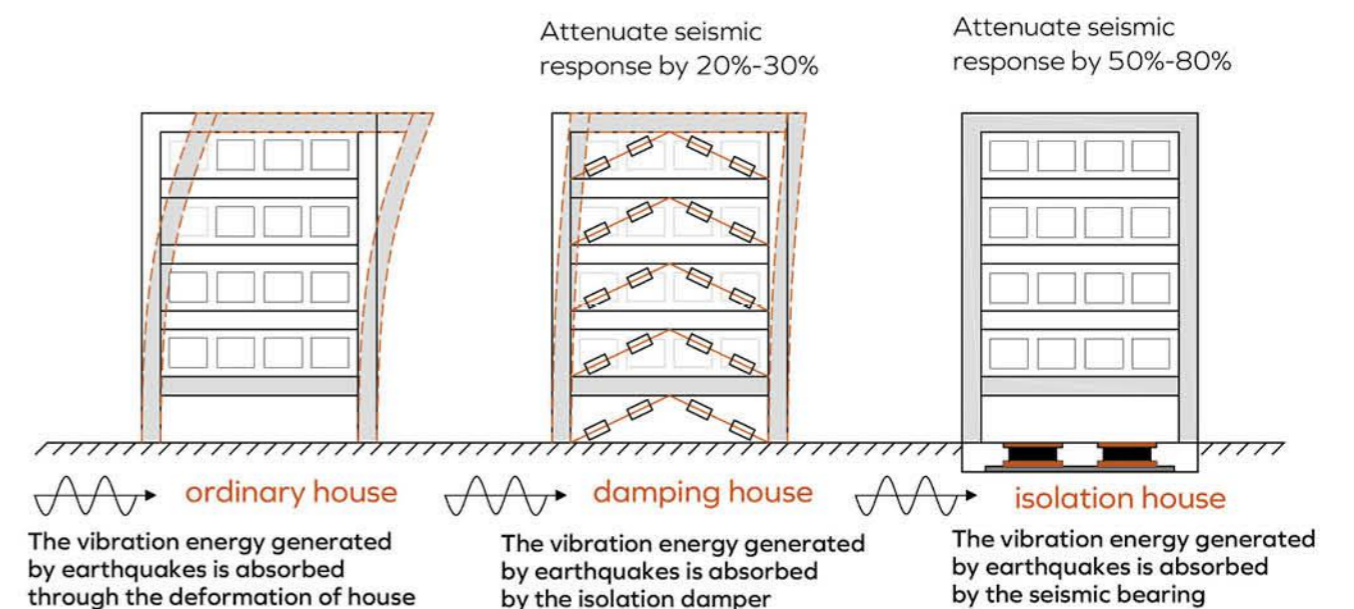


Shock-absorbing Technology

Adding devices with energy dissipation function in the superstructure can improve the damping ratio of the superstructure of the building, and the vibration reduction effect can reach 20% ~ 30%.

Seismic Isolation Technology

Seismic isolation bearings as a layer of flexible system are set between the superstructure and foundation of the building to change the vibration characteristics of the building structure (prolong the natural frequency of the structure). During an earthquake, the deformation of the flexible system converts the horizontal shaking of the upper structure into horizontal displacement of the flexible system, isolating and dissipating most of seismic energy transmitted to the upper building structure, thereby greatly improving the earthquake resistance of the building (the isolation effect can reach 50%-80%).



Elastomeric Isolation rubber bearing:

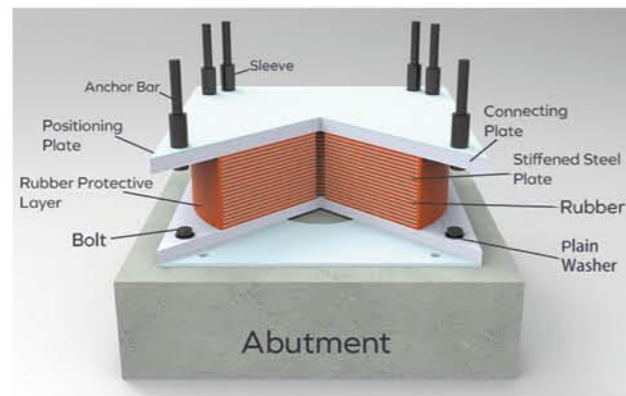
Seismic isolation bearing decouples the structure from its foundation during an earthquake by demonstrating high stiffness performance in vertical direction and softness in horizontal direction (shear and deformation and damping)

Application: widely used in the seismic isolation design and seismic reinforcement of bridges, buildings, hydropower projects and other civil structures.

Natural rubber bearing type II (LNR- II)



Made of multilayer natural rubber and multilayer steel plates alternately, with good vertical bearing capacity and horizontal deformation capacity. (The support and connecting plate are vulcanized as a whole)



Natural Rubber Bearing (LNR)

Features:

- The support is processed as a whole, more reliable connection;
- Excellent performance; Longer service life.

Natural Rubber Bearing Type II (LNR-II) Serialization Parameter Table

Specifications (diameter, mm)	/	D400	D500	D600	D700	D800	D900	D1000	D1100	D1200	D1300	D1400	D1500	D1600
Shear modulus G	Mpa	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total height of bearing H	mm	178	201	223	267	302	353	390	435	462	490	501	501	501
Total thickness of rubber layer Tr	mm	74	93	111	129	147	166	184	202	221	240	240	240	240
First form factor S1	/	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15
Second form factor S2	/	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5
Vertical compression stiffness Kv	kN/mm	1300	1700	1900	2400	2900	3600	4400	5300	6000	6800	8300	10000	11900
Horizontal equivalent stiffness (Shear strain 100%) Keq	kN/mm	0.68	0.84	1.02	1.19	1.36	1.53	1.70	1.88	2.05	2.21	2.56	2.94	3.34

High damping rubber bearing type II (HDR-II)



The laminated composite rubber isolation bearing with high damping performance is made by adding various ingredients in the natural rubber. The high damping rubber bearing not only maintains the good mechanical properties of the natural rubber bearing, but also has a high damping ratio, which can effectively absorb the seismic energy in the earthquake and reduce the impact of the earthquake.

Features

- Environmentally friendly, lead-free

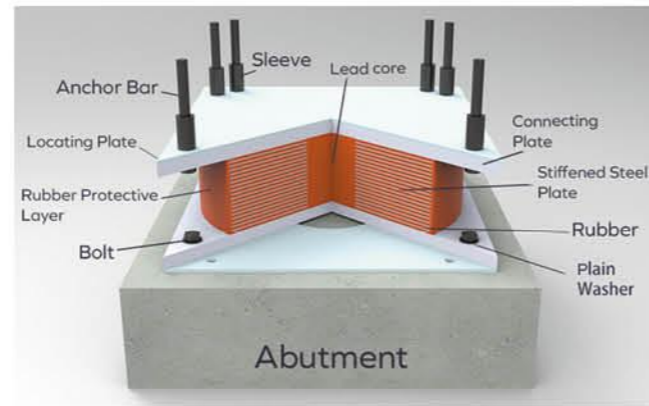
High Damping Rubber Bearing Type II (HDR-II) Serialization Parameter Table

Specifications (diameter, mm)	/	D400	D500	D600	D700	D800	D900	D1000
Shear modulus G	Mpa	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total height of bearing H	mm	178	201	223	267	302	353	390
Total thickness of rubber layer Tr	mm	74	93	111	129	147	166	184
First form factor S1	/	≥15	≥15	≥15	≥15	≥15	≥15	≥15
Second form factor S2	/	≥5	≥5	≥5	≥5	≥5	≥5	≥5
Vertical compression stiffness Kv	kN/mm	1350	1750	1950	2450	2950	3650	4450
Horizontal equivalent stiffness (Shear strain 100%) Keq	kN/mm	0.98	1.22	1.49	1.73	1.98	2.24	2.48
Yield force Q	kN	23	36	53	73	95	120	149
Stiffness after yield Kd	kN/mm	0.68	0.84	1.02	1.19	1.36	1.53	1.70
Stiffness before yield Ki	kN/mm	8.10	10.10	12.20	14.30	16.30	18.30	20.40
Equivalent damping ratio heq	/	18.0%	18.0%	18.0%	18.0%	18.0%	18.0%	18.0%

Lead rubber bearing type II (LRB- II)



Made of multi-layer natural rubber and multi-layer steel plate alternately laminated and vulcanized, and the vertical lead core is embedded inside, which has good vertical bearing capacity and horizontal deformation capacity, and the lead core can absorb earthquake energy when plastic deformation occurs, greatly increase energy consumption and wind resistance of earthquake-isolated buildings. (The support and the connecting plate are integrally vulcanized).

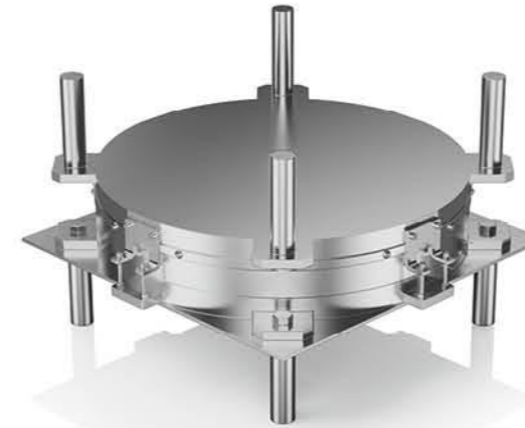


Lead Rubber Bearing (LRB)

Features:

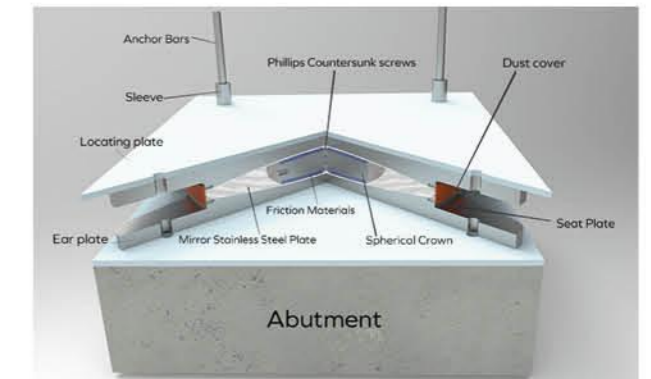
- The bearing is processed as a whole, and the connection is more reliable;
- The performance is excellent; Longer service life;
- Strong ability to consume earthquake energy

Application: Widely used in seismic design of high-rise buildings, seismic reinforcement and transformation, aerospace, machinery, industrial pipeline equipment, bridges, military and other fields



Friction pendulum System (FPS)

It is composed of steel and friction materials. The natural vibration period of the upper structure is extended by the relative sliding of the spherical sliding surface. The appropriate radius of curvature of the sliding surface is selected according to the required natural vibration period. The damping coefficient is controlled by the friction coefficient; The sliding limit bolt is set to ensure the stability of the building in non-earthquake, and easy to cut in earthquake to ensure the deformation capacity.



Friction pendulum System (FPS)

Features:

- Self-reset after earthquake;
- the vibration period is independent of the loaded mass.

Lead Rubber Bearing Type II (LRB-II) Serialization Parameter Table

Specifications (diameter, mm)	/	D400	D500	D600	D700	D800	D900	D1000	D1100	D1200	D1300	D1400	D1500	D1600
Shear modulus G	Mpa	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total height of bearing H	mm	178	201	223	267	302	353	390	435	462	490	501	501	501
Total thickness of rubber layer Tr	mm	74	93	111	129	147	166	184	202	221	240	240	240	240
First form factor S1	/	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15	≥15
Second form factor S2	/	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5
Vertical compression stiffness Kv	kN/mm	1400	1800	2100	2600	3100	3800	4700	5500	6200	7100	8600	10400	12300
Horizontal equivalent stiffness (Shear strain 100%) Keq	kN/mm	0.68	0.84	1.02	1.19	1.36	1.53	1.70	1.88	2.05	2.21	2.56	2.94	3.34
Yield force Q	kN	1.04	1.27	1.58	1.89	2.08	2.37	2.69	3.00	3.18	3.47	4.06	4.70	5.11
Stiffness after yield Kd	kN/mm	27	40	63	90	106	141	182	227	251	304	362	425	425
Stiffness before yield Ki	kN/mm	0.68	0.84	1.02	1.19	1.36	1.53	1.70	1.87	2.04	2.20	2.55	2.93	3.34
Equivalent damping ratio heq	/	23.5%	22.6%	24.0%	24.7%	23.1%	23.9%	24.6%	25.1%	23.9%	24.4%	24.8%	25.2%	23.2%

Building Friction Pendulum Support (FPS) Serialization Parameter Table

Support specification	Vertical bearing capacity	Support height	Vertical compression stiffness	Friction coefficient (slow) 0.02		Friction coefficient (fast) 0.05	
				Stiffness before yield	Equivalent stiffness	Stiffness before yield	Equivalent stiffness
FPS II-Vertical bearing capacity (kN)- Ultimate displacement (mm)-Swing period (s)	kN	mm	kN/mm	N/mm	N/mm	N/mm	N/mm
FPS II-1000-250-3.81	1000	105	667	8000	566	20000	998
FPS II-2000-250-3.81	2000	125	1333	16000	1132	40000	1996
FPS II-3000-250-3.81	3000	140	2000	24000	1697	60000	2993
FPS II-4000-250-3.81	4000	155	2667	32000	2263	80000	3991
FPS II-5000-250-3.81	5000	170	3333	40000	2829	100000	4989
FPS II-6000-250-3.81	6000	185	4000	48000	3395	120000	5987
FPS II-7000-250-3.81	7000	200	4667	56000	3960	140000	6984

Elastic sliding bearing and Friction Pendulum System

Sliding Isolators decouple structures from seismic excitation with movement at their sliding surface resulting in small base shear

Application: mainly used in seismic isolation design and seismic reinforcement of buildings, bridges and other civil structures.

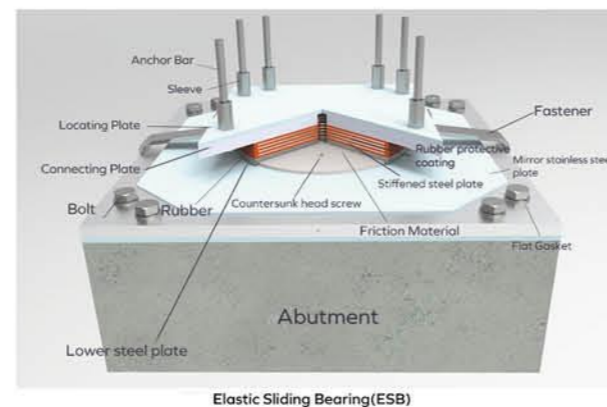


Features:

- Strong vertical bearing capacity;
- Low friction coefficient;
- The horizontal displacement is not limited by the rubber material.

Elastic sliding bearing (ESB)

The sliding bearing is composed of rubber bearing, sliding material, sliding panel and upper and lower connecting plates. The bearing has sufficient vertical compressive rigidity and bearing capacity; After the bearing starts to slide, the horizontal force of the bearing is only related to the friction coefficient and vertical pressure of the sliding contact surface.



Shock absorption products

Shock-absorbing products are capable to dissipate some of the energy transmitted to the upperstructure, increase damping ratio, and reduce structural damage.



Features

Viscous Fluid Damper (VFD)

A damping (vibration) device composed of high-strength metal cylinder, piston, guide rod, sealing element and viscous damping fluid. When the cylinder and piston move mutually, the damping force generated by the movement of the built-in viscous damping fluid can absorb the impact energy of the earthquake on the building structure to the maximum extent, and mitigate the impact and damage of the earthquake on the building structure.

- Good reliability;
- strong resistance to extreme impact;
- installation, maintenance and replacement are simple and convenient.

Installation procedure



Lower buttress steel bar binding



Installation of positioning plate and lower embedded components



Lower pier formwork support protection



Concrete pouring



Grinding and leveling the top surface of the lower pier



Support positioning installation



Installation of pre install compnents

Engineering Service

To ensure optimal product performance, Tiantie uses specialized computer and predictive modeling software during the design process. In addition to Tiantie's seismic bearing products, the company also provides expert installation services and/or

supervision. Experienced engineers are available for installation and commissioning of all our products, including on-site monitoring and adjustments, installation reports confirming "as-built" characteristics can also be provided.

Product Testing

Product and performance testing is carried out at our in-house test lab. This allows for fast turn-around and quick response to customers. To keep pace with technical requirements and latest industry trends and innovations, Tiantie's lab and test facilities are continuously expanded with new equipment and processes.



Innovation and product development are the essence of Tiantie's corporate philosophy. Engineering experts are actively participating in national and international committees. Tiantie's commitment to innovation, along with close collaboration with universities, consulting firms and customers, provide a solid basis for the development of next generation state-of-the-art products. Continuously changing market conditions, evolving technology and new technical requirements demand timely responses and action. Tiantie's extensive in-house laboratories and testing facilities are well equipped to perform application testing or performance verification testing quickly and effectively.



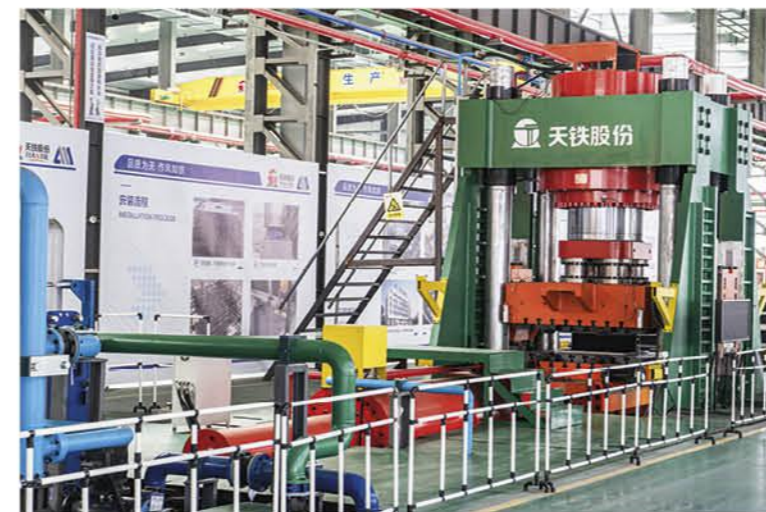
Production

Wholly-owned Zhejiang Tiantie production plants are large scale manufacturing facilities. State-of-art production equipment and processes ensure highest quality products that meet customer needs, on-time delivery, as well as regulatory requirements for environmental protection. Company production plant is equipped with sophisticated, intelligent and environmental protection large-scale production facilities. Building isolation production plant has an annual capacity of 50,000 sets.

The company takes "intelligent manufacturing and green manufacturing" as the leading factor, empowers products with ultra-high process standards, explores upgrading traditional manufacturing with Internet factories, and relies on digital system

platforms such as intelligent and highly monitored, M and environmentally friendly large-scale production equipment to produce for the company High-quality products provide an important hardware foundation.

The company has a national CNAS-certified experimental center, which can provide professional and accurate testing services. The experimental center has 5000kN, 20000kN electro-hydraulic servo dynamic compression shear testing machine, 2500kN electric 3ron0 damping machine universal testing machine, dynamic and static fatigue testing machine, ozone testing machine, aging test chamber and other professional testing and R & D equipment.



Quality Control

Global markets require compliance with a variety of different standards. Tiantie's Quality Management System ensures that product and process standards are consistent, in compliance, and documented in accordance with standards. Test reports, certifications and customer testimonials are available on request.



Occupational Health and Safety System according to ISO 45001



Environmental Management system according to ISO 14001



Quality Management System according to ISO 9001

References

Over 11900 of Tiantie building isolation products have been successfully installed.



School Atushi, Xinjiang



Residential buildings, Urumqi, Xinjiang



University Training

Selected Tiantie Seismic isolation Projects

Project	Construction area	Quantity used
Liangshan Science and Education Park and medical education service project	270,000 m ²	675 sets
Changji People's Hospital New District Hospital Construction Project (Phase I)	310,000 m ²	612 sets
Qijing Medical College Malone Campus construction project	310,000 m ²	945 sets
Langfang Fenghua Senior High School project	65,000 m ²	451 sets
Dali Midu County Fuyaju project O	33,000 m ²	112 sets
Wujinshan Middle School renovation and expansion Project	78,000 m ²	382 sets
Linfen City Central Hospital outpatient complex building O	240,00 m ²	185 sets
CRRC Sifang Zhihui Port Phase I project - Professional and residential facilities	189,000 m ²	2175m2
Nanjing G111 Project (36-9 Block in Southwest China) TOD	85,000 m ²	1313m2



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